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Integrating Social Capital into Institutional Analysis of the Guangxi CDM Forest-based Carbon Sequestration Project

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Executive Summary

This research is funded under the financial support of the IDRC Fellowship No. 003591-102. The project funded by EEPSEA, entitled "Integrating Social Capital into Institutional Analysis—Some Empirical and Methodological Examinations", has two components:

Component 1: Integrating Social Capital into Institutional Analysis for the first CDM Forest Project in the World.

Component 2: Measuring Trust in an Ethnically Diverse Region in China

This report presents the first component of the research, while a separate report has been made for the second component.

Paying developing countries for carbon sequestration is a vital component of climate change mitigation. If appropriately designed, these payments can also transfer income to poor villagers, which can help achieve the goals of long-term sustainability for the carbon sequestration project and of poverty reduction. Using data on reforestation and a survey of village stakeholders, this paper made an assessment whether or not the world's first CDM forest-based carbon sequestration project implemented in China could simultaneously reach its environmental and developmental objectives. Although the Guangxi project is widely heralded as a model CDM project, still less than half of the project land remain unforested at the time of surveys conducted in September of 2007[1]. The survey revealed one major cause to relatively low participation to the carbon project, highlights the important role of social capital in this initiative.

[1] It is important to note that at the time of survey, the project was still under the implementation stage. Big progresses on tree plantings have been made since the survey time.

1. INTRODUCTION

Interest in implementing CDM forest projects has been increasing, especially after the 13th Conference of Parties (COP 13) of the United Nations Framework for Climate Change Conventions (UNFCCC) held in Bali in 2007. In the conference, projects on reducing emissions from deforestation and ecosystem degradation (REDD) were added to the list of eligible CDM forest projects that originally included only afforestation/reforestation projects.

In developing countries, ideal CDM forest projects, especially small-scale ones, should be accessible and profitable so as to benefit local land users. At the same time, these projects should effectively provide a global environmental service – that is, climate change mitigation. However, designing and implementing CDM forest projects is challenging. While the first CDM forest project in the world that is implemented in China is showing many signs of success, only about 55 percent of the designed tree-planting activities have been accomplished. What may be the reason for the low participation rate of the local communities and the low project outcome?

Using the field data from China's CDM project area, this study evaluated the project, specifically the roles played by institutional arrangements and social capital in project implementation. Findings can guide the design and implementation of future CDM forest projects, especially in developing countries.

The CDM forest projects are funded through a payment for environmental services (PES) system, where buyers from developed countries make direct payment to sellers in developing countries for carbon credits. The carbon credits are generated by carbon sequestration through afforestation/reforestation activities or through reduced emissions from deforestation and ecological degradation (REDD) resulting from conservation activities. These direct payments benefit the service providers of climate change mitigation who are usually small-scale land users or among the poor in the community (Pagiola et al., 2005). Hence, improvement of local livelihood is an integral part of CDM forest projects (Smith and Scherr, 2003).

To truly benefit from the CDM forest projects, local land users must be willing and able to participate in the PES system (Pagiola, 2007). Their willingness to participate is largely determined by the profitability of participation, while their ability to participate is affected by technical and financial constraints, high transaction costs, investment costs, and tenure issues. In other words, they will only be willing to participate when they are better-off by participating, and the payment level is at least equal to the opportunity cost of their second-best land use (Pagiola et al., 2005; Pagiola et al., 2007). However, their technical and financial constraints can be partly relaxed by some institutional and contractual arrangements, such as upfront payment, access to credit, market, and technical assistance (Pagiola et al., 2005; Wunder, 2005; Tschakert et al., 2007).

High transaction costs are commonly associated with forest carbon projects (Milne, 1999; van Kooten, Shaikh, and Suchanek, 2002). These costs typically include expenses

for project design, regulatory approval, validation, registration, information search, negotiation, signing and implementation of contracts, monitoring, insurance, verification and certification (Australian Greenhouse Office, 2005; Milne 1999), communication with project partners, and fulfillment of contracted obligations by all parties (Smith and Scherr, 2003). Some transaction costs, such as those for project design, approval, validation, registration, and monitoring are fixed regardless of the project size. These fixed transaction costs account for the major part of the transaction costs in forest carbon projects (Australian Greenhouse Office 2005, Milne 1999). Therefore, the average transaction costs for individual small-scale land users to undertake forest carbon sequestration projects can be high. As such, transaction costs must be seen as critical factors in designing and implementing CDM forest projects that are truly accessible to poor and small-scale land users.

Pooling or bundling individual activities of potential but poor participants to make them more competitive and letting smallholders sign collective contracts so as to spread the transaction costs over a larger group have partially addressed the problem of transaction costs (Australian Greenhouse Office, 2005; Grieg-Gran et al., 2005; Wunder, 2005; Pagiola, 2007). Pooling has the major advantage of reducing transaction cost and risk because [1] pooling through the aggregation and bundling of individual activities can reduce the average transaction cost, given that the major part of the transaction costs associated with forest carbon projects, such as costs of project design, approval, validation, registration and monitoring, is fixed regardless of the project size (Australian Greenhouse Office 2005, Milne 1999); [2] pooling can help disperse small-scale land users' risks since the risks can be scattered over a larger geographical area in case of disasters (Richardson 2005) and smoothed against yearly fluctuations across individual plots and fields (Carter 1987). However, by design, pooling requires collective actions, the success of which can be dependent on formal and informal institutions. Informal institutions are closely related to social capital, which is generally defined as the connections among individuals, i.e., networks, norms, trust, concern for one's associates, and willingness to sanction violators of rules or norms (Bowles and Gintis, 2002; Putnam, 2000).

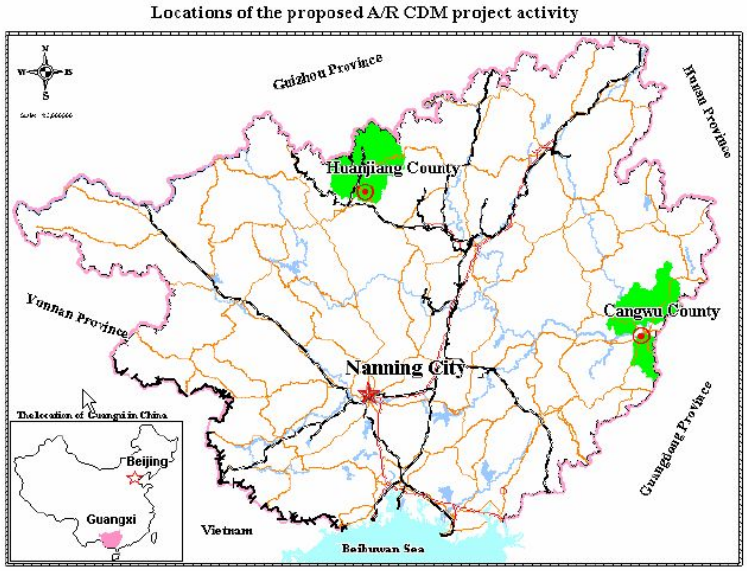
Social capital facilitates and maintains cooperation in collective actions by reducing mutual monitoring cost; increasing the credibility of social sanction; facilitating interactions among individuals; providing common knowledge or information about the reliability of their peer members; and helping organize information sharing and coordination of activities (Sobel, 2002; Grootaert, 1998; Besley et al., 1993). A high level of social capital reduces the cost of monitoring and enforcing formal rules among individuals in the management of common pool resources (Gibson et al., 2005). Social capital is often an alternative (substitute) for formal institutions to maintain cooperation towards collective actions among a common pool of resource users (Ostrom, 1992). However, when the initial social networks of mutual reciprocity, obligations, and sanctions existing at the local level are not strong enough to enable local resource users to take collective actions that would jointly benefit them, formal institutions should be created. The share-holding system adopted by China's world forest project has enabled collective actions at the local area.

China's first CDM forest project, *Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin in China* (hereafter called *Guangxi project*), can represent the design and implementation of similar CDM forest projects elsewhere. First, it shares common characteristics with other CDM projects such as the high transaction and establishment costs. Second, its implementation is affected by technical, institutional, and socio-economic factors. For instance, local communities withdraw from the project because of contractual rules and tenure issues, and their low participation in the project results to technical difficulties in rehabilitating seriously degraded lands. Third, while there is wide global interest on the implementation of CDM forest projects, we lack information or lessons from the field. Hence, this research tried to assess the constraints in designing and implementing these projects among small-scale land users, especially in developing countries.

The paper had three main objectives: [1] to evaluate the performance of the project; [2] to assess the impacts of social capital and contractual rules on project implementation; and [3] to draw some useful lessons for the design and implementation of future CDM forest projects.

2. GUANGXI CARBON PROJECT

The Guangxi carbon project, a part of a World Bank's umbrella project entitled "Guangxi Integrated Forestry Development and Conservation Project", was designed to reforest 4,000 ha of multiple-use forests on seriously degraded and remote lands to reach multiple environmental and developmental objectives. The area started to be developed in early 2005, and it became the world's first CDM forest project that was registered in the CDM Executive Board (EB) in 2006. It is being implemented in Cangwu and Huanjiang Counties in China's Southern Province of Guangxi (Map 1).



Map 1. A Location map of the Guangxi Carbon Project

Data source: Guangxi Project Development Document, 2006

2.1. Multiple environmental and developmental objectives of the project

The establishment of 4,000-ha multiple-use forests on seriously degraded marginal lands aimed to address multiple environmental and developmental objectives. These included carbon sequestration, biodiversity enhancement, soil erosion control, and improved local livelihood. The multiple-use forests were planned to be established using a combination of six tree species. Of the 4,000 ha of land to be regenerated, 3,000 ha of lands would be planted with a mixture of five native tree species and 1,000 ha would be planted with one single tree species - eucalyptus (*Eucalyptus sp.*) (Table 1).

Table 1. Multiple tree species to be planted by the project

Tree species	Cangwu (ha)	Huanjiang (ha)	Species ratio	Rotation age (years)
Eucalyptus	500	500	100%	10
Sweetgum: Chinese red pine	0	1050	6:4	17:30
Sweetgum : Chinese fir	0	450	6:4	17:30
Chinese red pine : oak	900	0	6:4	30:7
Chinese red pine: Chinese Gugertree	600	0	6:4	30:17
Total	2000	2000		

Data source: Guangxi Project Development Document, 2006

The project was expected to sequester 0.77 megatons (Mt) of CO_2e over a 30-year crediting period (2006-2035), with about 0.34 Mt of CO_2e by 2012 and 0.46 Mt of CO_2e by 2017. The carbon benefit would be generated using environment-friendly techniques in planting the six tree species selected.

The six tree species have different carbon sequestration rates and rotation periods (Table 1), thus they were expected to produce a relatively smooth annual net carbon sink curve and deliver a stable amount of carbon credits over the crediting period. Some species like oak, eucalyptus, and sweetgum, having higher growth rate but shorter rotation period, can sequester carbon at a higher rate in the early stage of the crediting period. Other species like Chinese fir and Chinese red pine, having lower growth rate in the early stage but longer rotation period, can sequester a higher total amount of carbon over the whole crediting period. Figure 1 presents the annual and accumulative carbon sink of the project.

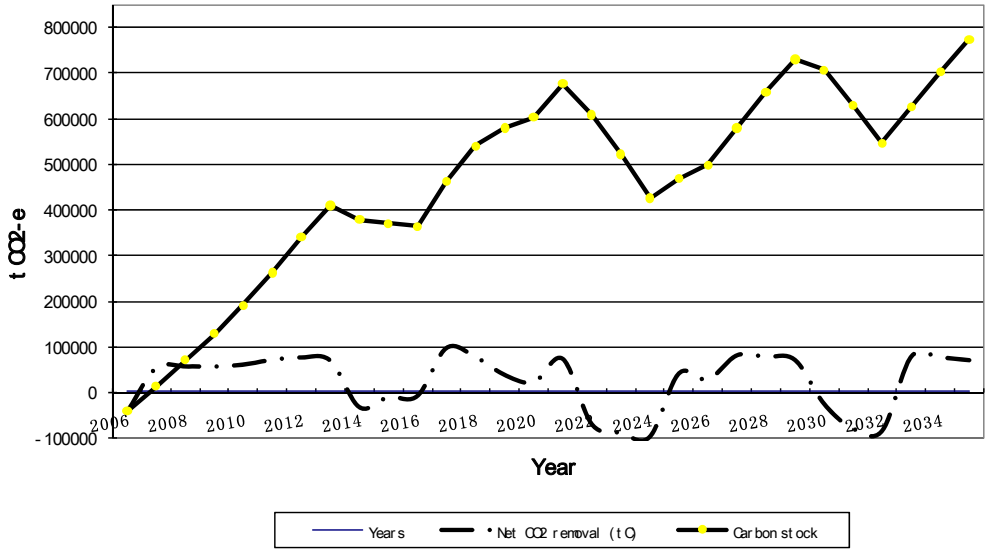


Figure 1: annual and accumulative carbon sinks by the Guangxi carbon project

Data source: Guangxi Project Development Document , 2006

The project was also expected to generate other environmental benefits such as biodiversity enhancement and soil erosion control. The project's forest coverage would be expanded by 1.34%. The soil erosion control in seriously degraded lands would be improved. Since some of the regenerated lands were located adjacent a national nature reserve, regenerated forests were seen to shelter wildlife and enhance the viability of wildlife populations in the protected areas (Project Development Document, 2006).

Local livelihood was expected to improve through the generation of income and the creation of employment opportunities. For instance, harvesting and selling of timbers and pine resins were allowed in the project area as guided by the Project Development Document (2006). The expected total income from selling certified carbon credits was US$ 2.0 million; of timber products, US$ 5.5 million; and of pine resins, US$ 3.5 million. This expected revenue would be shared among the local communities and the three local forest companies according to mutually agreed upon revenue-sharing rules under the share-holding system (details are discussed later). The income generated was especially important for ethnic minorities living in remote areas of the Huanjiang County, who speak little or no Chinese but their own ethnic language, and who have little outside options for earning cash income. The local communities could also expect employment and income from the project through tree planting, weeding, harvesting, resin collection, and forest management.

2.2. Project baseline and "additionality"

For a CDM project to deliver real carbon benefits, it must demonstrate "additionality"[2], implying that the carbon sequestration added by a CDM project would not have occurred otherwise (Haupt and von Lüpke, 2007). The stated baseline of the Guangxi CDM project is that the barren lands would "remain abandoned and degrade" (section B.2 in PDD, 2006). Before the CDM forest project, most of the 4,000 ha of lands were predominantly covered with grasses or shrubs, except for about 35 ha covered with scattered trees. While these lands, which were mainly deforested in 1960s, were restricted to forest use under the Chinese law, they have not been reforested before the CDM project because of the lack of private or public investment. The Guangxi CDM project then was an 'additional' because without carbon financing, the project would not likely be reforested.

Before the CDM project, the private business sector had little incentive to reforest the seriously degraded and remote lands because of the low rate of return on investment (section B.3 of PDD, 2006). Along with the carbon financing, the provincial and local governments contributed additional financial support and coordination to overcome some previous financial and institutional barriers faced by reforestation projects. In this sense, the provincial and local governments, in facilitating the project, acted as intermediaries. In terms of economic returns, without the mix of carbon financing and government financial support, investment on regenerating seriously degraded and remote lands had an internal rate of investment (IRR) of only 8.53%, which is lower than the required rate of return (12%) set by the Chinese government for forest investment (section B.3 of PDD, 2006). With the additional revenue from carbon credits sold at a fixed price of US $4.5/ton of CO2e for the crediting period of 2006 to 2035 and with incomes from the sale of carbon credits combined with government financing, the IRR of the investment increased to 15.02% (section B.3 of PDD, 2006) – a rate that made forest investment attractive.

2.3. Land tenure arrangement in the project area

The 4,000 ha of lands (2,000 ha in Cangwu and 2,000 ha in Huanjiang) covered by the project had two types of land tenure arrangements, i.e., individual lands (1098.4 ha) and communal lands (2,901.6 ha). The individually managed lands had been contracted to each farmer's households under a 50-year contract period since the early 1980s. The communal lands, on the other hand, were being managed by natural villages[3]. About 55% (1098.4 ha) of lands in Cangwu were individual lands and the remaining 45% (901.6

[2] To prove "additionality", the project developers need to show that either the project is not economically or financially attractive without the additional payment, or it would not be able to overcome legal, technological or ecological barriers without the income of carbon credits (Haupt and von Lüpke, 2007).

[3] The Guangxi project involved both communal lands managed by natural villages and lands managed by individual famer households. In the Chinese context, natural villages are communities where people live together, while an administrative village consists of several natural villages, some of which may be located far away from each other.

ha) were communal lands; all 2000 ha of lands in Huanjiang were communal lands. Some communal lands (mainly in Huanjiang County) did not have clearly delineated boundaries among natural villages.

2.4. Pooling arrangement and the share-holding system

The pooling arrangement and the share-holding system were unique arrangements adopted by the Guangxi carbon project. These systems were expected to create economies of scale so that financially and technically constrained small-scale and local land users could participate in the project and regenerate their barren lands. The pooling arrangement bundled barren lands from 27 villages (15 from Cagnwu and 12 from Huanjiang) to form a total project size of 4,000 ha (2,000 ha in Cangwu and 2,000 in Huanjiang). The share-holding system, on the other hand, was created among the local communities and the three local forest companies. Figure 2 presents the framework of the share-holding system.

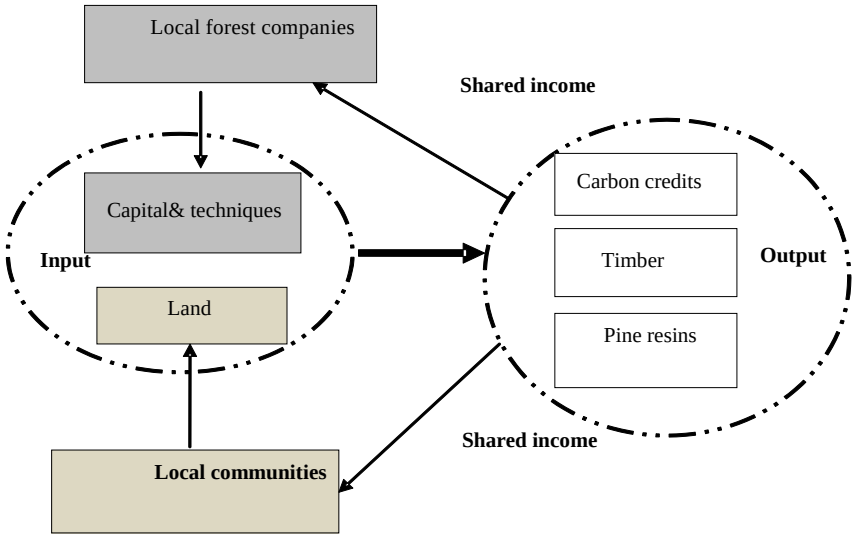


Fig. 2 A share-holding system created by the Guangxi carbon project

The share-holding system involved two groups of stakeholders: the three local forest companies (two from Cangwu and one from Huanjiang) and the local communities from the 27 villages. To facilitate the participation of the local communities, three contractual rules were provided. First, the three local forest companies were fully responsible for investing capital and techniques on project design, forest regeneration and management, harvest and sale of the products; and for providing some necessary technical support and trainings to the local communities regarding the carbon project. The local communities only needed to invest their individually managed or communal barren lands to the project. Second, the forest companies were allowed to regenerate 1,000 ha of eucalyptus plantations by leasing lands from local communities at the local land rent prevailing in

2005 for 2006 to 2035 and to get subsidized loans and government financial support. Third, the local communities would receive 40% of the income from the sale of timber and pine resins and 60% from the sale of carbon credits produced from the 3,000 ha of forests planted to five native tree species other than eucalyptus. The local communities would only get income when the products have been sold.

2.5. The collective contractual arrangement

To pool the carbon credits and reduce the transaction costs, the collective contracts were signed following three steps. First, the buyer, BioCarbon Fund, signed an overall contract with the Luhuan Forestry Development Company from Huanjiang County, which represented all sellers under the share-holding system. Second, the Luhuan Forestry Development Company signed individual contracts with the other two forest companies, Kuangyuan and Fuyuan forest farms from Cangwu County. Third, for communal lands, the three forest companies signed contracts with local community leaders. The community leaders further coordinated the income-sharing among the community members and with other communities. For individual lands, the forest companies signed the contracts directly with the household heads.

2.6. Financial arrangements for the project

Subsidized loans and government financing were the major financial arrangements for the project. For a total project investment of US$ 2,822,282, about 40% (US$ 1,128,913) of the investment was made through subsidized loans at a rate of 6.21% to the local forest companies. About 40% (US$ 1,128,913) was financed by the Government of the Guangxi, and about 20% (US$564,465) was financed through commercial loans.

The financial arrangements were intended to increase the economic attractiveness of the project and provide small-scale local forest companies with incentives to invest in CDM forest projects. This was because the more financially competitive, large-scale commercial forest companies were reluctant to invest on the CDM forest project. It is quite understandable given the much longer return period of investment and the lower return rate compared to commercial plantation projects. Hence, hope was pinned on the small-scale local forest companies to invest on reforestation in remote and degraded lands for carbon sequestration and for local livelihood improvement.

3. THEORY AND PROPOSITIONS

The research made three propositions on the roles played by social capital and contractual arrangements in the implementation of the Guangxi carbon project. The propositions were tested using anecdotal evidences collected from the surveyed villages.

Proposition 1: When the social capital in the local area, such as density of social networks and collective norms, is not strong enough to enable local communities to coordinate among themselves so that they can collectively participate in the CDM carbon

project, the pooling arrangement and the share-holding system created for the project are an effective substitute for the social capital to enable collective actions among the local communities.

Proposition 2: When the income-sharing contracts are incomplete, i.e., the contracts do not consider all possible contingencies that can happen in the future, and the local communities do not trust their potential partners, the income-sharing contracts cannot provide incentives for the local communities to participate in a long-term relationship with the local forestry companies, despite the foreseeable profits from participation.

***Proposition* 3**: When there is no clear delineation of property rights over the land, dispute resolution mechanisms, and mutual trust among local communities, income-sharing contracts cannot be enforced.

4. METHODOLOGY

This section discusses an assessment framework that was used to evaluate the Guangxi carbon project and the data used to fulfill the objectives of the research.

4.1. An overall assessment framework

An assessment framework (Fig. 3) was developed to guide the evaluation of the project by focusing on two major objectives of the project, i.e., carbon sequestration and local livelihood enhancement. The framework was based on the original concepts of Hanley et al. (1999), Pagiola et al. (2005), Pagiola (2007), and Wunder (2005). However, it was extended to consider contractual rules, social capital, and uncertainties.

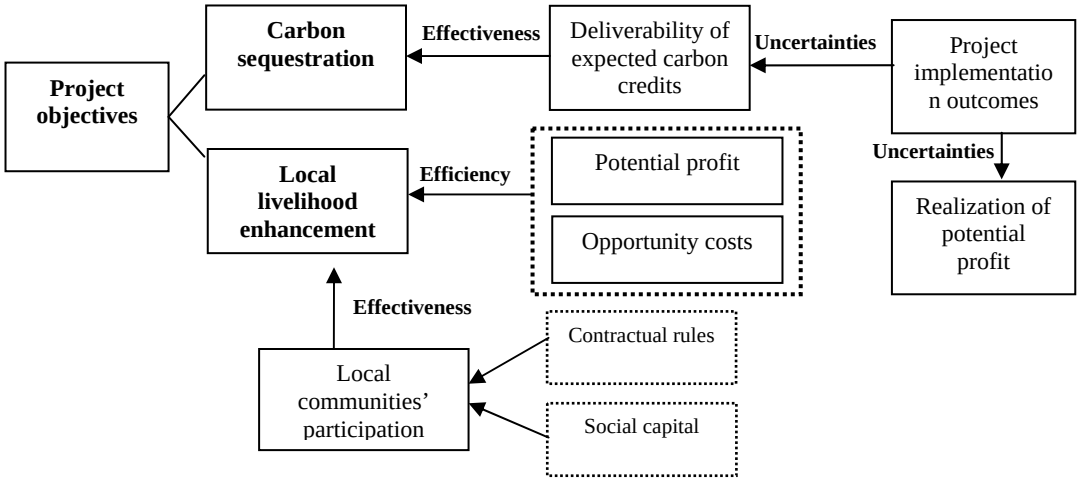


Fig. 3 An assessment framework for the Guangxi carbon project

Efficiency and effectiveness, which are commonly used in evaluating policies (Hanley et al., 1999) and programs (Bacha and Rodriguez, 2007; Sierra and Russman, 2006), were used to evaluate the two major objectives of carbon sequestration and local livelihood enhancement. Measured were the efficiency of local livelihood enhancement (objective 1) and the effectiveness of carbon sequestration and local livelihood enhancement (objectives 2 and 3). Efficiency was measured in terms of [1] profitability to local communities from their participation, which can determine their incentive to participate in the project; [2] the overall profitability of the project because in order for the local communities to profit, the overall project should be necessarily profitable as well; [3] the opportunity costs to local communities in participating in the CDM project in terms of forgone benefits from leasing their lands to commercial companies that develop industry plantations. Effectiveness, on the other hand, was measured by the expected deliverability of the carbon credits and by the local communities' participation level.

The evaluation framework included the impact of contractual rules and social capital or the participation of the local communities. Contractual rules, such as revenue-sharing rules and upfront payment, could determine the local communities' expected revenues and their revenue streams, and thus, their ex ante incentives to participate in the project. Social capital, on the one hand, could affect collective actions (Baland and Plauteau, 1996; Ostrom, 1991), and collective actions can be induced by the carbon pooling and share-holding system designed for the Guangxi carbon project.

Added to the evaluation framework was uncertainty. The implementation of long-term CDM forest carbon projects entails uncertainties, which were evaluated by project outcomes rather than by absolute quantitative terms. Project outcomes were important in evaluating the overall performance of the project; these were used to evaluate the realization of potential profitability and deliverability of expected carbon credits.

Not considered yet in the evaluation framework were other environmental objectives of the project, such as biodiversity enhancement and soil erosion control. This is because during the 2007 surveys, the project had only been implemented for two years, and there were still no discernable soil erosion control and biodiversity enhancement benefits.

4.2. Data

Both primary and secondary data were collected for the research.

Secondary data were obtained from government reports; field data collected by the local government regarding the implementation of the project; and raw data used to draft the Project Development Document that was submitted to the CDM Executive Board. The secondary data were used to evaluate the project implementation outcomes; calculate the profitability of project to local communities, and analyze the possible contributing factors to the current undesired outcomes, if they exist.

Primary data were collected through personal interviews with local community leaders and through focus group discussions conducted in 14 villages, or over 50% of all

villages involved in the project, in September of 2007. Personal interviews were mainly conducted using questionnaires, while the focus group discussions were conducted using semi-structured questionnaires. The focus group discussions were also held for staff members of local government officials, who were coordinating the project, and for managers of the local forest companies.

Information collected from the focus group discussions held in surveyed villages mainly included socio-economic conditions, social relationships, land tenure issues, and contractual arrangements. This information served as anecdotal evidences to test the propositions on the roles played by social capital and contractual rules in the design and implementation of the Guangxi carbon project. Ideally, the measurement of the roles of social capital and contractual rules has to rely on rigorous econometric models using detailed survey data. However, given that the project was largely implemented in the villages, conducting detailed household surveys was not quite feasible. Common research methods in social sciences or humanities, such as the narrative and qualitative methods using anecdotal evidences (Marcus, 1998; Densin and Lincoln, 2005: Yin, 2003; Geertz, 1973), were used to test the study's three propositions.

Village leaders were personally interviewed to collect primary data that would confirm and update the field inspection data collected by the local government agencies and other relevant secondary data, which were used to calculate the profitability of the project.

Stratified sampling was applied to choose the villages to be covered in the study. First, the villages were stratified into three strata according to the progress of the project's implementation. These were [1] villages with sound (full or almost full) implementation; [2] villages with medium level of implementation; and [3] villages with no implementation. Second, within each stratum, villages to be surveyed were randomly sampled.

5. RESULTS AND DISCUSSION

Carbon pooling arrangement, share-holding system, and financial arrangements through subsidized loans and government financing were the major elements that contributed to the success of China's CDM project.

5.1. Project implementation outcomes and causes

Field inspection data from the local government agencies showed that only 55% (about 2,210 ha) of the overall reforestation plan (4,000 ha) had been completed in September 2007. Further, only 85% and 45% of the designated areas for plantations of eucalyptus and native tree species have been planted, respectively. Reasons for low accomplishments were obtained from information from the local government agencies and focus group discussions with the villagers (Table 2.

Table 2. Reasons for low level of plantation accomplishment

By reasons / By counties	1. Restrictive contractual rules and insufficient trust causing local land users to withdraw (ha)	2. Impossible to regenerate extremely infertile lands (ha)	3. High cost of regenerating remote and degraded lands (ha)	4. Privately-held lands that were planted to crop trees instead (ha)	5. Land tenure disputes combined with weak social capital (ha)	6. Other reasons (ha)	Total (ha)
Cangwu	305	0	0	14	49	253	621
Huanjiang	64	257	639	49	134	16	1159
Overall	369	257	639	63	183	270	1780
Proportions in total	21%	14%	36%	4%	10%	15%	100%

As shown in Table 2, the major causes of reduced tree planting included the following:

[1] About 369 ha or 21% of the unplanted portion of the project's lands (mostly individually-managed lands in Cangwu) have been withdrawn from the original contracts with the local forest companies. The first reason for the withdrawal of these lands was the increase in the opportunity cost of participation. After the contract was signed, rental of lands in this area of Cangwu increased because of competition for barren lands from commercial forest companies that wanted to develop eucalyptus plantations. Land-users were also trying to renegotiate for a larger share of profits from timber products, resins, and carbon credits. Ironically, the higher rental rate offered by the commercial forest companies for developing eucalyptus plantation may indicate that they would willing to forest these lands without the benefit of carbon money, hence making these lands no longer 'additional'. However, at the time of survey, local land users were still negotiating with the local forest companies.

[2] At least 14% (257 ha) of the area designated for reforestation would not be regenerated because of the extreme infertility of the severely degraded lands; such a problem was not identified during the project development stage.

[3] Over one-third of the unplanted lands faced particularly high cost and technical difficulties associated with reforestation. These lands were seriously degraded and located in extremely remote communal lands in Huanjiang.

[4] Other privately-held land was used to plant crop trees, specifically oranges in Cangwu. After the project was signed, orange prices increased, raising the opportunity cost of participating in the CDM project for these producers. As crop trees sequester carbon, as with those lands in [1], these privately-held lands no longer met the 'additionality' requirement.

[5] Unresolved land tenure disputes contributed to 10% (183 ha) of unfinished plans.

Obstacles created by unresolved land tenure disputes for local communities to reach mutually agreed ratios for income-sharing could be alleviated if the local communities had sufficient social capital to coordinate among themselves the sharing of expected income. Lack of social capital made this potential solution in some administrative villages impossible.

[6] About 10% (171 ha) of the unfinished plan was a result of a delayed schedule in tree planting because the villages were holding out for road-building before allowing planting to proceed (part of reason 6 in the Table 2).

Although at least 14% of the area slated for reforestation could not be regenerated because of their extreme infertility, informants from the focus group discussions said that about half of the unfinished tree planting plans could be planted subject to reasons 1, 3 and 5 in Table 3. These lands could be planted if more favorable contracts were offered to the local land users, if coordination for land dispute resolution is improved, and if stronger technical support was provided to regenerate seriously degraded lands. However, as noted above, there was a question as to whether those lands in [1] would still satisfy the 'additionality' requirement because the community's alternative use (driving up their reservation utility) was also forestry-related.

Essentially, the major elements leading to current failures could be categorized as: [1] unfavorable income-sharing ratio between local land users and local forest companies; [2] inability of the buyer's homogeneous payment level to consider the heterogeneity of designated lands and the absence of upfront payment; [3] low level of some local land users' trust in their trading partners, the local forest companies; and [4] unclear delineation of land tenures.

5.2. Potential profitability: providing potential benefits to local communities

The overall project was potentially profitable with financial arrangements made for the project and with the additional income from sales of carbon credits. The net present values (NPVs) of the project were all positive at a discount rate of 12%, except for the extreme scenario of the high land rent combined with low product prices. The computation of NPVs took into account all the investors, recalculated under four different scenarios representing different levels of opportunity cost of the lands and product prices. The IRR of the overall project also passed the required rate of return (12%) set by the Government of China for the approval of a CDM forest-based carbon sequestration project.

From the financial point of view, participating local communities gained positive NPV by simply investing their lands in the CDM project and by sharing income with the local forest companies through the share-holding system, Hence, they should be willing to participate in the project. However, under the current contractual rules, they would get payment only upon the harvest of products. Table 3 shows the NPVs under different discount rates.

Table 3 Potential profit and opportunity costs of project to local communities

Scenarios	NPV at 8% (US$)	NPV at 12% (US$)	NPV at 20% (US$)
1) NPVs of profit: low land rent prevailing in 2005, low product prices	2,531,472	1,449,493	650,748
2) NPVs of profit: high land rent prevailing in 2007; low product prices	1,370,804	619,010	137,424
3) Expected total income from leasing land to a commercial company at the prevailing prices in 2005	372,158	266,287	164,593
4) Expected income from leasing land to a commercial company at the prevailing prices in 2007	1,532,826	1,096,770	677,917

Table 3 shows that the local communities' NPVs participating in the project were all positive at different discount rates under scenarios 1 and 2. These were [1] when the product prices were on the low bound and the opportunity costs of the lands were on the low bound; and [2] when the product prices were on the low bound and the opportunity cost of the land were on the upper bound. Results indicated that the NPVs would also be positive under scenarios with medium or high levels of product prices.

Scenarios 3 and 4 in Table 3 represent the local communities' NPVs from the second-best use of their lands, i.e., leasing the land to the commercial companies at low land rentals and high rentals, respectively. These two scenarios were essentially the local communities' opportunity costs of participating in the CDM project under the assumptions that all the lands covered in the CDM project were productive enough to be rented to commercial companies. Therefore, scenario 4 represents the upper bound of the local communities' opportunity cost of participating in the project.

Comparison of the local communities' NPVs of benefit showed the following: when the land rentals of leasing lands to the commercial companies were maintained at 2005 prevailing prices, the local communities' profit from participating in the CDM project was expected to be higher than their foregone benefit of leasing the lands to commercial companies at a discount rate of 8% or 12%. However, when the land rentals were increased to the prevailing prices in 2007, the local communities' profit from participating in the CDM project was lower than their foregone benefit of leasing the lands to commercial companies. This can explain why some local communities withdrew from their original contracts with local forest companies upon the increase of land rental prices starting 2005.

5.3. Uncertainties of expected deliverability of the carbon credits and realization of potential profitability

Given the poor implementation outcomes and pending solutions to problems in the project, it was highly uncertain for the local communities to realize the profitability of their participation and to expect the delivery of their carbon credits. The expected delivery of carbon credits in 2008 was delayed because the project's implementation lagged behind schedule. Moreover, the 14% degraded lands, which were impossible to reforest, affected the amount of expected deliverable carbon credits during the crediting period. The latter held true if replacement for this portion of land outside the current project boundaries was allowed by the CDM EB. Realization of the local communities' potential profitability would depend on the negotiation outcomes between the local communities and the local forest companies, the resolution of land tenure disputes, and the technical support provided.

5.4 Carbon pooling: resulting in low level of transaction costs

The pooling arrangement entailed a relatively low level of average transaction cost in the Guangxi carbon project. The average transaction cost of the project was estimated at about US$1.26 /t$CO_2$e, which was calculated from the secondary data used in the Project Development Document. These were on the lower bound of the average transaction cost (US$ 1 /tCO_2e to US$ 235/tCO_2e) of community-based forest carbon sequestration projects (Milne, 1999) and one-fifth of the average transaction cost (5.41//tCO_2e) of forest carbon projects of the Actions Implemented Jointly (AIJ) implemented in the past in other developing countries (Milne, 1999). The relatively low level of transaction costs was mainly attained through pooling in order to create economies of scales.

5.5. The share-holding system: allowing for the poor and small-scale local communities to participate

Before the CDM forest project, the local communities were plagued with various problems such as high establishment and transaction costs; degraded lands; weak social capital in some villages; poor access to financial markets; and inadequate technical skills to regenerate degraded and remote lands in the project area. However, the share-holding system integrated with carbon pooling and collective contractual arrangements created economies of scale and substituted for the weak social capital. Thus, this system enabled the local communities to participate in the project through collective actions.

The high establishment and transaction costs, together with the small size of individual lands owned and prevalent poverty, made it impossible for the local communities to implement reforestation on their own. In the Guangxi carbon project, the establishment costs to regenerate the barren lands included the costs for tree planting and road construction to reach the remote lands. Surveys showed that about one-third of the lands in the villages did not have road access before the project's implementation. Given the average distance of about 2.8 km from the main roads and concerned project lands,

the average cost for constructing roads was estimated to be US$ 124 per ha. The total transaction cost for the Guangxi carbon project was estimated to be US$ 971,817, of which 60% was the fixed transaction cost. This total transaction cost included project development cost, validation cost, annual verification cost and cost for due diligence by BioCarbon, negotiation cost, coordination cost, and other implementation costs.

As for the lands, the average size of individual lands covered in the project ranged from 0.3 ha/family to 7.9 ha/family in Cangwu. Other local communities, especially those in Huanjiang, were poor and did not have access to local loans, hence making it difficult to implement the CDM forest project by individual members.

The poor nature of the communal lands, together with the weak social capital in some communities, likewise made it difficult for the local communities to regenerate the communal lands on their own. Some community leaders revealed during the surveys that their communities either did not have financial means or incentives to take collective actions to regenerate their communal lands. One reason for the lack of incentives to act together was the weak social capital, such as weak norms of mutual reciprocities, in some communities. One typical example cited by some village leaders was as follows: while some villagers who had incentives attempted to regenerate their barren communal lands, other villagers who could earn incomes outside tree plantings and thus had little use of these lands, did not like their co-villagers benefiting without them benefiting as well, hence they prevented their co-villagers from reforesting these communal lands.

The local community leaders pointed out that it was only through the share-holding system created by the Guangxi carbon project that they were able to participate in the project and start reforesting their barren lands. Previously, they lacked economies of scale in tree planting as well as technical skills and financial resources. The share-holding system combined the comparative advantages of the local communities and local forestry companies. While the local communities had barren lands but lacked finance and skills to design and implement the CDM forest project, local forest companies with no lands had strong technical and financial capabilities for project development and implementation. Hence, the local communities could commit their barren lands to the CDM project over a 30-year period and share income with the local forest companies according to the ratios mutually agreed upon during the project development stage. The local forest companies, on the other hand, would take full responsibilities for forest regeneration, forest management, and sale of products. Therefore, the share-holding system provided a viable means for the local communities to participate in the project.

Further, the share-holding system helped substitute for the social capital needed for the local communities to engage in collective actions, such as participating in the project to gain joint benefits and welfare improvement. Social capital embedded in informal institutions, like users groups within rural communities, provides central sustainable solutions to pursue sustainable livelihood and resource management that often involve rural communities' collective actions (Pretty and Ward, 2001). Also, networks of mutual obligation encourage entrepreneurship within the local communities (Miguel et al., 2005). However, when the social capital in the local area, such as density of social networks and collective norms, is not strong enough to enable local communities to

coordinate among themselves to collectively participate in a project, the share-holding system could be an effective substitute for social capital.

In the Guangxi carbon project, social capital was vital because while the local communities could collectively commit their barren lands to the CDM project to form a minimum project size for economies of scale to operate, collective actions could not take place spontaneously. This was essentially the statement of proposition 1, which can be proven by anecdotal evidences from two villages in the project area.

Anecdotal story 1: *Success of share-holding system to enable collective action of local communities in Xinlong and Datong villages*

The villages of Xinlong and Datong in Cangwu County used to experience frequent field fires (two to three times a year). This was because some local communities traditionally burned crop stalks for fertilizer to enhance their agricultural productivity. However, the fires often razed the adjacent barren lands. The villages also never regenerated these barren lands before the CDM project, revealed the village leaders. This was because first, because of the high risk of fires, commercial forest companies did not rent the barren lands. Second, the village members had few incentives to plant trees, not only because of the high risks of fires, but also because norms of mutually monitoring and punishing members who ruin young trees were very weak in the villages. Third, norms of mutual reciprocity were very weak, and networks that could play the role of coordinators in the villages were lacking.

There was low labor supply for regenerating the barren lands, especially the communal barren lands, because some villagers had other options apart from the project. They usually had family members working in cities or earning off-farm incomes. On the other hand, some villagers who had few options tried to regenerate the communal lands to earn incomes. However, as mentioned earlier, some villagers opposed the scheme. Laws in China stipulate that whoever plant trees can own the trees and earn income, even from trees that they would plant in communal lands. Villagers with good outside options and benefiting little from the actions of villagers with few outside options did not allow the latter to regenerate the communal barren lands.

The above problem was not addressed. No individuals or associations in the villages took a lead in discussing or coordinating among the villagers any benefit-sharing schemes so that the villagers can support each other and ensure that any initiatives for reforestation by some members would be successful. As a result, the communal lands had been barren since they were deforested in the early 1980s. As some village leaders lamented during the interviews: “Members in our villages do not like others to benefit from the communal barren lands.”

The share-holding system, however, addressed the local communities’ previous constraints for participation and enabled them to undertake collective actions. The local communities could expect a certain share of income in the future by collectively contributing their barren lands to the CDM project, while the local forest companies would take full responsibility for the production and sale of products from the project. Under these expectations, the local communities were willing and able to participate in the CDM project. Indeed, all designated barren lands (100%) for the carbon project in Xinlong Village and 97% of the designated lands in Datong Village have been successfully regenerated by the time of the surveys.

5.6 Trust: vital for project implementation

The low level of trust of some local communities on their partners - the local forest companies - partly explains why even the share-holding system was unable to engage local communities in the potentially profitable project. Trust matters, especially when contracts signed between the villagers and the companies may be unable to cover all contingencies in the future, hence involving risks. If the local communities did not sufficiently trust the local forest companies, they would believe that the latter would harm their interests after the contracts were signed. Because of this perception, some local communities decided not to enter into income-sharing contracts with the local forest companies, even if they quite foresaw the profitability of their participation. This situation was illustrated in Dayan Village where the local communities' participation was extremely low.

Anecdotal story 2: local communities' low trust in their partners leading to zero participation rate in Dayan village.

In Dayan Village, located in Shatou Township in Cangwu, 86.7 ha of individual lands were designed to be planted with Chinese red pine and oak trees. However, the tree planting, which was planned to be accomplished in the spring of 2007, never materialized. With the intervention of local forest agencies, the local forest companies eventually agreed to provide the villages with a special contract wherein they would assume responsibility for the tree plantings while giving the local communities the future incomes from the project. Despite the obvious advantage of this contract, the local communities in Dayan Village still hesitated to sign the contract. Rather, they preferred to plant trees on their own with the necessary technical and financial support from local forest companies or local forest agencies.

During the village-level focus group discussions, the village members admitted that they did not believe that they would get full income from the trees planted if the local forest companies were also involved in the tree plantings. According to the villagers, since laws in China stipulated that "whomever plant trees owns trees", then the local forest companies can later claim future incomes from the trees even if they promised otherwise. Their real concern actually was not in the income sharing per se, but rather on the possibility that the forest companies (who were also involved in forest planting and management) would claim all the income from products that would be produced and sold. Because of extreme lack of trust on local forest companies, the local communities did not participate in the CDM project's share-holding system.

5.7. Land tenure disputes and weak social capital

Land tenure disputes and weak social capital constrained some local communities in making collective decisions on land investment and income distribution as demonstrated in Cuishan Village.

Anecdotal story 3: land tenure disputes and weak social capital made enforcement of income-sharing contracts difficult in Cuishan Village.

Based on the village-level surveys, Cuishan has 20 natural villages, and the farthest distance between the two natural villages was about 15 km. About 80% of the households had access to electricity, but only one natural village had road access.

The village had a total area of 426 ha of communal lands covered by the CDM project. The communal barren lands were left as is or used for grazing. The natural villages initially agreed to participate in the CDM project when the project was still in the development stage. However, about 30% (126 ha) of the lands could not be successfully planted because these were not clearly delineated among the different natural villages. Further, these villages could not coordinate among themselves to resolve tenure disputes and agree on mutually accepted income-sharing contracts. The villagers had few interactions because of inaccessible roads and sparsely distributed natural villages. In addition, because most of the recently appointed village leaders were in their middle ages and were involved in off-farm activities, they could not effectively coordinate among natural villages. As a result of land tenure disputes and weak social capital in the villages, some natural villages decided to postpone their participation in the CDM project until the disputes were resolved. The resolution would come through the coordination efforts of external government agencies, such as local forest agencies. These agencies have developed relatively strong bonds with the village through their previous technical extension services.

6. CONCLUSIONS

The Guangxi forest carbon project has been quite a success by creating a unique share-holding system that was integrated into the pooling and collective contractual arrangements in communities. This system enabled local communities with technical, financial, and institutional constraints to participate in and benefit from the project, which was potentially profitable with subsidized loan policy and government financing support. The share-holding system also helped create economies of scale through the reduction of transaction costs, which were commonly high for forest carbon projects.

The project was potentially a win-win option for the local communities and the local forest companies, who were the key stakeholders of the share-holding system, because the project was profitable to both parties. However, only 55% of the overall reforestation plan had been accomplished because of the technical challenges faced in regenerating seriously degraded lands; the withdrawal of the local communities that were unsatisfied with the original contracts offered by the local forest companies from the project; and the land tenure disputes. Moreover, the project faced many difficulties in fulfilling at least 14% of its remaining reforestation plan. The plan's implementation, however, can be improved considerably through better contractual arrangements; coordination for tenure conflict resolutions; and technical support from external expert teams. The non-fulfillment of the remaining plan can reduce the efficiency gain of the project and expected deliverability of the carbon credits specified by the PDD.

Social capital interacted with the contractual rules underlying the share-holding system to impact the local communities' ability and willingness to participate in the project. Participation was critical for realizing the key objective of enhancing local livelihood in the project area. When the social capital in the local area was not strong enough to induce participation, the share-holding system was an effective substitute to enable local communities to take collective actions for joint benefits. On the other hand, the feasibility of income-sharing contracts underlying the share-holding system depended on the local communities' level of trust on their partners, i.e., the local forest companies. Moreover, when land boundaries among local communities were not well-defined, social capital such as the local communities' mutual trust and existing networks in the local area for conflict resolution can be affected and reduce their willingness to take collective actions for joint benefits.

Two implications can be drawn from this research regarding the design and implementation of CDM forest projects. First, when the local social capital is weak, certain effective contractual arrangements must be created to enable local communities take collective actions. Second, with weak social capital to support self-enforcement mechanisms of local communities, land tenure issues (such as unclear delineation of the boundaries of the lands) can critically hamper the implementation of the CDM forest projects.

REFERENCES

Australian Greenhouse Office. (2005). *Planning Forest Sink Projects: A Guide to Carbon Pooling and Investment Structures.* Australia: Australian Greenhouse Office.

Bacha, C. J. C. and Rodriguez, L. C. E. (2007). Profitability and social impacts reduced impact logging in the tapajos national forest, brazil - A case study. *Ecological Economics, 63*, 70-77.

Barrett, C. B., Lee, D. and McPeak, J. (2005). Institutional arrangements for rural poverty reduction and resource conservation. *World Development, 33*(2), 193-197.

Ferraro, P. and Kiss, A. (2002). Direct payments to conserve biodiversity. *Science, 298*, 1718-1719.

Gjertsen, H. (2005). Can habitat protection lead to improvements in human well-being? Evidence from marine protected areas in the Philippines. *World Development, 33*(2), 199-217.

Grieg-Gran, M., Porras, I. and Wunder, S. (2005). How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. *World Development, 33*(9), 1511-1527.

Hanley, N., Whity, M. and Simpson, I. (1999). Assessing the success of agri-environmental policy in the U.K. *Land use Policy, 16*, 67-80.

Haupt, F., von Lüpke, H, 2007. Obstacles and opportunities for afforestation and reforestation projects under the Clean Development Mechanism of the Kyoto Protocol. FAO Advisory Committee on Paper and Wood Products. Shanghai, China, 6 June, 2007.

Kosoy, N., Martinez-Tuna, M., Muradian, R. and Martinez-Alier, J. (2007). Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America. *Ecological Economics, 61*(2-3), 446-455.

Milne, M. (1999). *Transaction costs of forest carbon projects* (Working Paper CC05. ACIAR project ASEM 1999/093). Australia: University of New England.

Ostrom, E. 1991. Governing the Commons. Cambridge: Cambridge University Press.

Pagiola, S. (2007). Payments for environmental services in Costa Rica. *Ecological Economics, In Press, Corrected Proof*

Pagiola, S., Arcenas, A. and Platais, G. (2005). Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. *World Development, 33*(2), 237-253.

Pagiolaa, S., Ramírez, E., Gobbic, J., de Haana, C., Ibrahimc, M., Murgueitiod, E. et al. (2007). Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecologica Economics, 64*, 374-385.

Project Development Document (PDD) for AR-AM0001: facilitating reforestation for Guangxi watershed management in pearl river basin, China. CDM Executive Board.

Sierra, R. and Russman, E. (2006). On the efficiency of environmental service payments: A forest conservation assessment in the Osa Peninsula, Costa Rica. *Ecological Economics, 59*(1), 131-141.

Smith, J. and Scherr, S. J. (2003). Capturing the value of forest carbon for local livelihoods. *World Development, 31*(12), 2143-2160.

Tschakert, P. (2007). Environmental services and poverty reduction: Options for smallholders in the Sahel. *Agricultural Systems, 94*(1), 75-86.

Tschakert, P., Coomes, O. T. and Potvin, C. (2007). Indigenous livelihoods, slash-and-burn agriculture, and carbon stocks in Eastern Panama. *Ecological Economics, 60*(4), 807-820.

UNFCCC (United Nations Framework Convention on Climate Change). (1997). *Kyoto Protocol to the Convention on Climate Change*. Bonn, Germany: The Climate Change Secretariat.

van Kooten, G. C., Shaikh, S. L. and Suchanek, P. (2002). Mitigating climate change by planting trees: The transaction costs trap. *Land Economics, 78*(4), 559-572.

World Bank. (2008). *Guangxi integrated forestry development and conservation project.* http://web.worldbank.org/external/projects/main?pagePK=104231&piPK=73230&theSitePK=40941&menuPK=228424&Projectid=P088964 (Retrieved March/17, 2008)

Wunder, S. (2005). *Payments for environmental services: Some nuts and bolts.* Center for International Forestry Research (CIFOR) Occasional Paper No. 42. Jakarta, Indonesia: CIFOR.

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